Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
Inventors: GREEN et al.
Page 1 of 23

Fig. 1A *(prior art)*

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
Inventors: GREEN et al.
Page 2 of 23

Fig. 1B

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
Inventors: GREEN et al.
Page 3 of 23

Fig. 2A

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
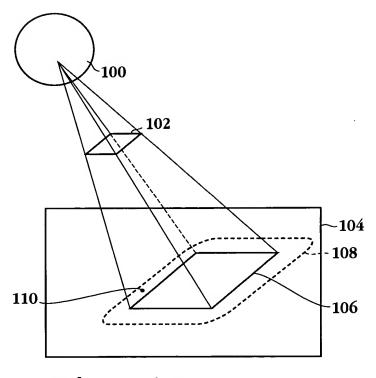Inventors: GREEN et al.
Page 4 of 23

Fig. 2B

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
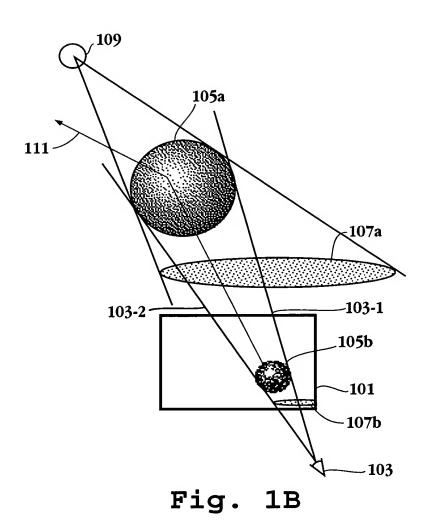Inventors: GREEN et al.
Page 5 of 23

Fig. 2C

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
Inventors: GREEN et al.
Page 6 of 23

114

Fig. 2D

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
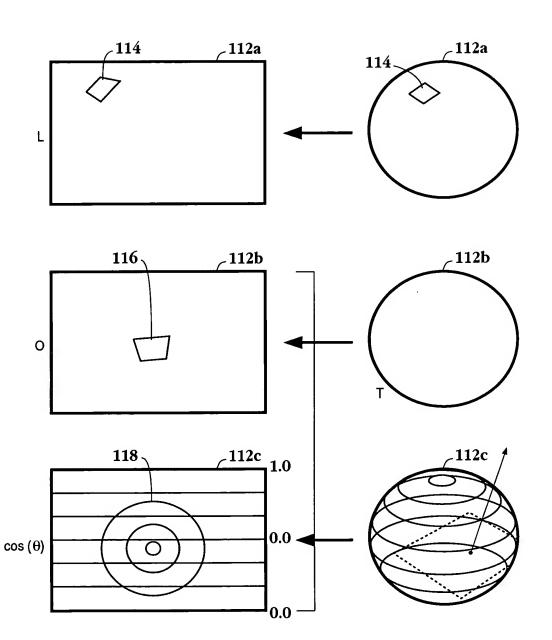Inventors: GREEN et al.
Page 7 of 23

Fig. 2E

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
Inventors: GREEN et al.
Page 8 of 23

Fig. 2F

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
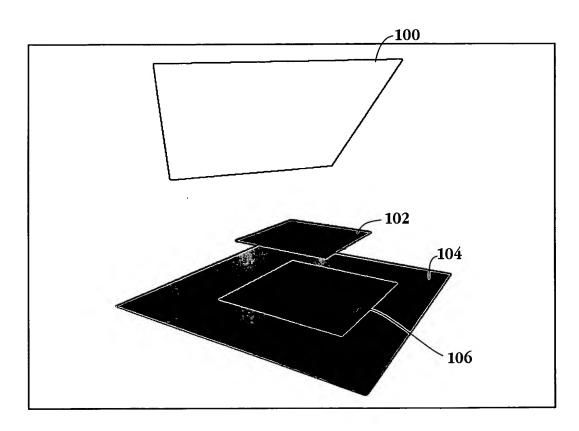Inventors: GREEN et al.
Page 9 of 23

Fig. 2G

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
Inventors: GREEN et al.
Page 9 of 23

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
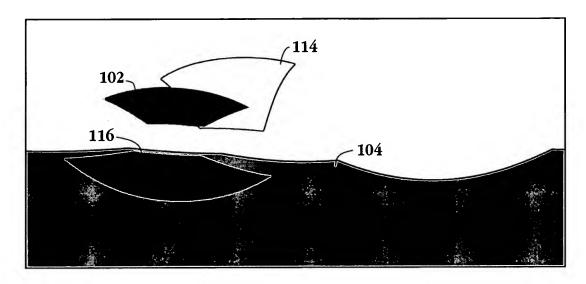File No.: SONYP024
Inventors: GREEN et al.
Page 10 of 23

Fig. 3

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
Inventors: GREEN et al.
Page 11 of 23
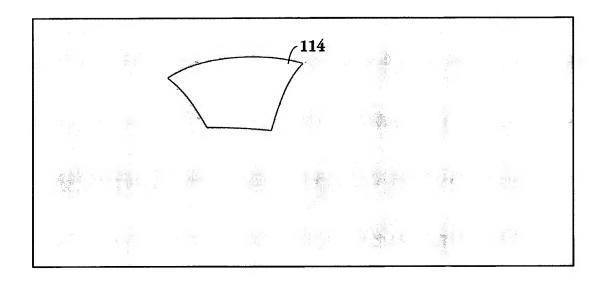
Fig. 4A

Fig. 4B

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
Inventors: GREEN et al.
Page 12 of 23

150a

World Space

152a

152b **154**

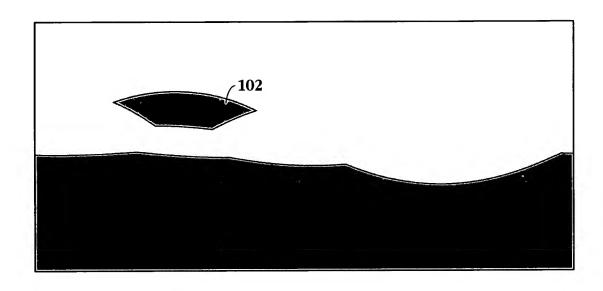v

u

Texture Map

150b

Screen Space

y

x

Fig. 5

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
Inventors: GREEN et al.
Page 13 of 23

146

142

3D Space

148

Texture Map

142-2

144

142-1

Screen Space

Fig. 6

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
Inventors: GREEN et al.
Page 14 of 23

154

157-1

156-1

157-2

155

156-2

157-3

156-3

Screen Space (x, y)

Fig. 7

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
Inventors: GREEN et al.
Page 15 of 23

Fig. 8

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
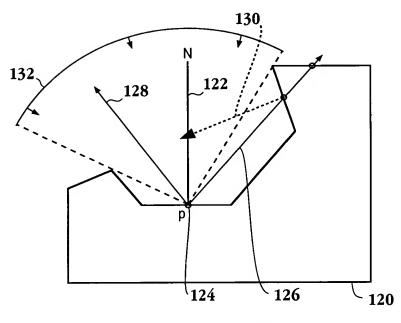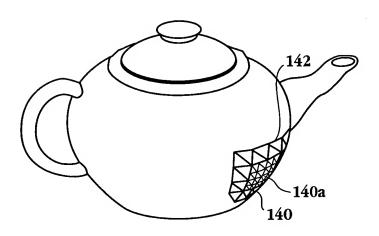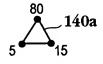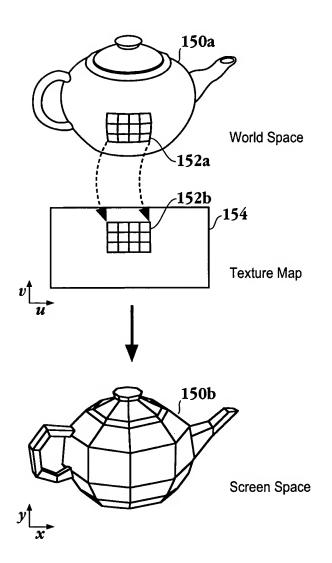Inventors: GREEN et al.
Page 16 of 23

```
                        ╭─────────────╮
                        │    Begin    │
                        ╰──────┬──────╯
                               │
                               ▼
        ┌──────────────────────────────────────────────────┐
        │   Generate a texture map associated with the image│──── 180
        └──────────────────────────────────────────────────┘
                               │
                               ▼
        ┌──────────────────────────────────────────────────┐
        │    Calculate a value representing a lighting      │──── 182
        │      characteristic for each of the texels        │
        └──────────────────────────────────────────────────┘
                               │
                               ▼
        ┌──────────────────────────────────────────────────┐
        │                Store the value                    │──── 184
        └──────────────────────────────────────────────────┘
                               │
                               ▼
        ┌──────────────────────────────────────────────────┐
        │   Associate a coordinate space of the texture map │──── 186
        │      with a display screen coordinate space       │
        └──────────────────────────────────────────────────┘
                               │
                               ▼
        ┌──────────────────────────────────────────────────┐
        │ Render the image on a display screen using the stored value │──── 188
        └──────────────────────────────────────────────────┘
                               │
                               ▼
                        ╭─────────────╮
                        │    Done     │
                        ╰─────────────╯
```
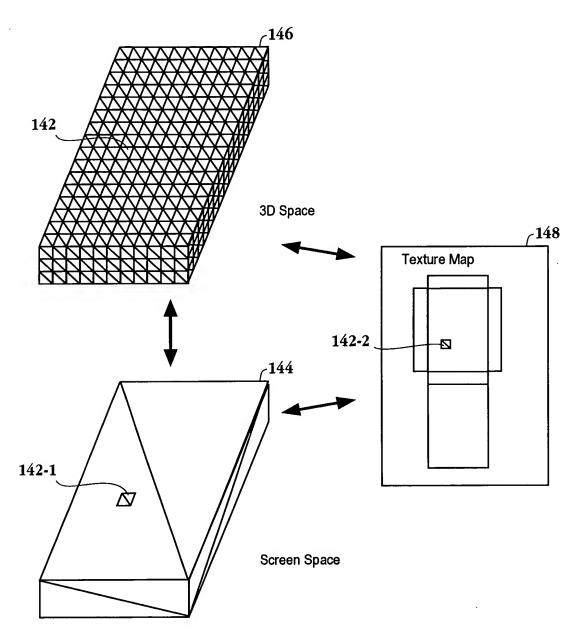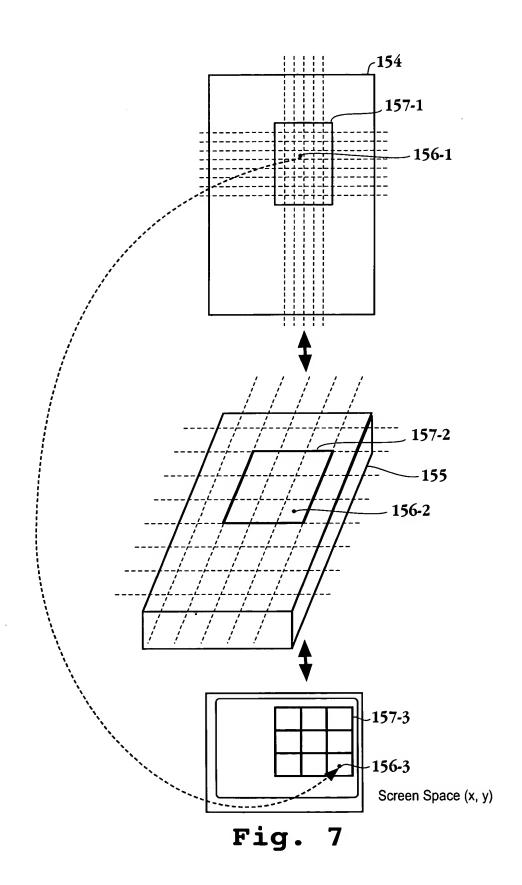
Fig. 9

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
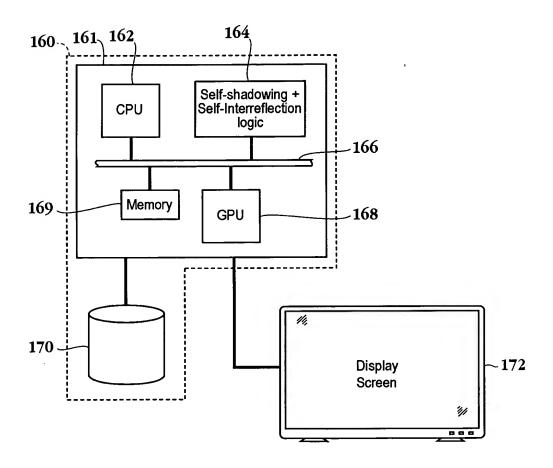Inventors: GREEN et al.
Page 17 of 23

Server

262

Internet

254

256

260

259

202

Media

Storage

268

Fig. 10

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
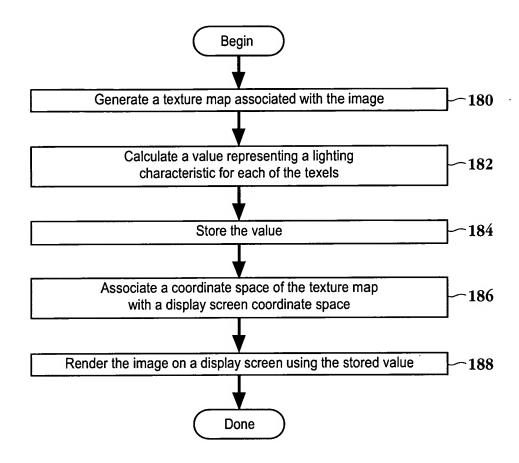Inventors: GREEN et al.
Page 18 of 23

Fig. 11

Fig. 12A

Fig. 12B

Fig. 12C

Fig. 12D

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
Inventors: GREEN et al.
Page 19 of 23

Fig. 13A

Fig. 13B

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
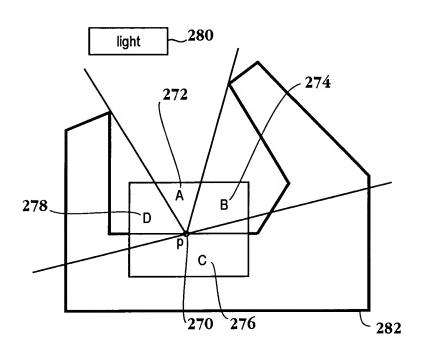Inventors: GREEN et al.
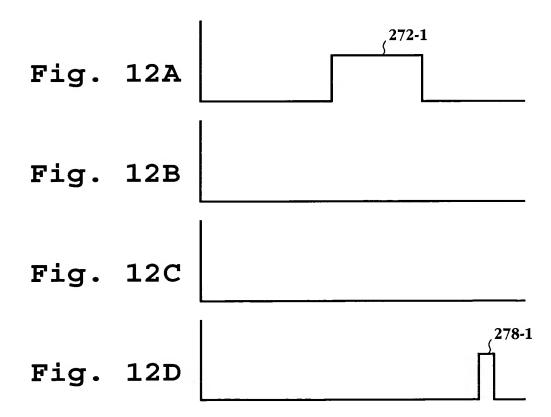Page 20 of 23

Fig. 14

Fig. 15

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
Inventors: GREEN et al.
Page 21 of 23

Fig. 16

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
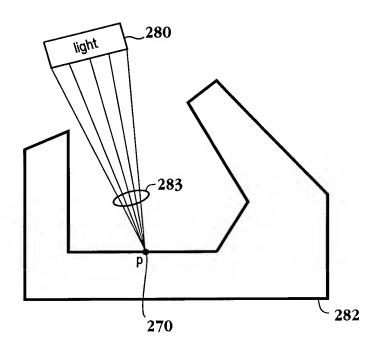Inventors: GREEN et al.
Page 22 of 23

$$\boxed{\text{Begin}}$$

↓

| Execute a ray tracing algorithm through a stream processor | —330 |

↓

| Generate a ray associated with a point on the display object | —332 |

↓

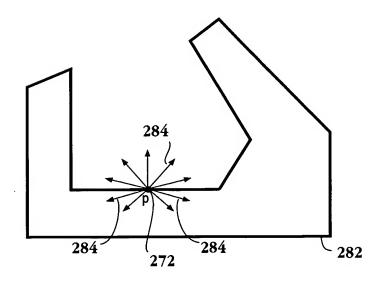| Determine an approximation of a transfer function component using at least one basis function | —334 |

↓

$$\boxed{\text{Done}}$$

Fig. 17

Title: Method and Apparatus for Real-Time Global
Illumination Incorporating Stream Processor Based
Hybrid Ray Tracing
Application No.: 10/645,819
File No.: SONYP024
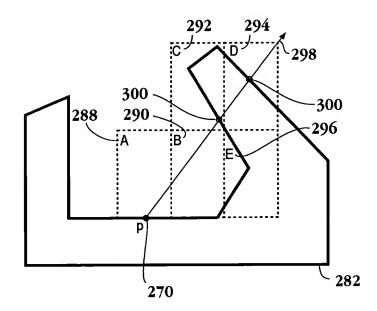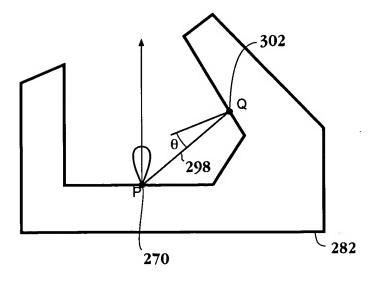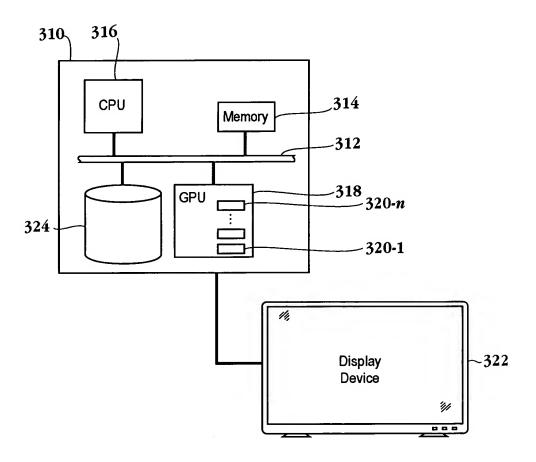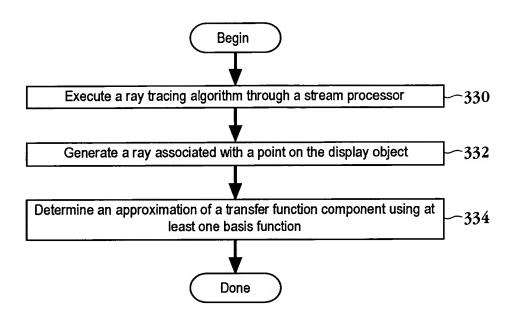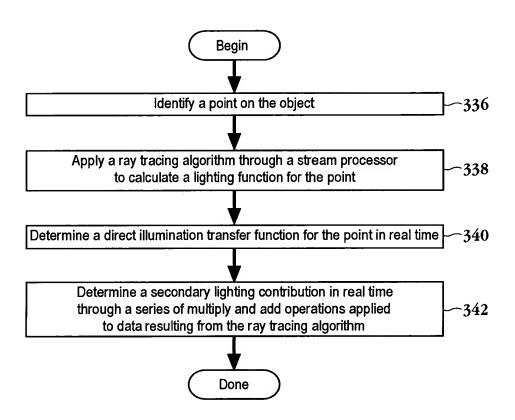Inventors: GREEN et al.
Page 23 of 23

```
            ╭──────────╮
            │  Begin   │
            ╰──────────╯
                 │
                 ▼
  ┌─────────────────────────────────────────────┐
  │        Identify a point on the object        │───336
  └─────────────────────────────────────────────┘
                 │
                 ▼
  ┌─────────────────────────────────────────────┐
  │ Apply a ray tracing algorithm through a      │
  │ stream processor                             │───338
  │ to calculate a lighting function for the point│
  └─────────────────────────────────────────────┘
                 │
                 ▼
  ┌─────────────────────────────────────────────┐
  │ Determine a direct illumination transfer     │───340
  │ function for the point in real time          │
  └─────────────────────────────────────────────┘
                 │
                 ▼
  ┌─────────────────────────────────────────────┐
  │ Determine a secondary lighting contribution  │
  │ in real time                                 │
  │ through a series of multiply and add         │───342
  │ operations applied                           │
  │ to data resulting from the ray tracing       │
  │ algorithm                                    │
  └─────────────────────────────────────────────┘
                 │
                 ▼
            ╭──────────╮
            │  Done    │
            ╰──────────╯
```

Fig. 18